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Laparoscopic cholecystectomy using the PINPOINT endoscopic fluorescence imaging system with intraoperative fluorescent imaging: A case report

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ABSTRACT

We report on a laparoscopic cholecystectomy performed using the PINPOINT endoscopic fluorescence imaging system (Novadaq, Mississauga, ON, Canada), which enables surgery to be performed while simultaneously viewing fluorescent images. The patient was a 43-year-old man diagnosed with cholecystolithiasis. Indocyanine green (ICG) was administered 18 h prior to surgery. The PINPOINT system made it possible to perform the procedure while viewing ICG fluorescence in the cystic duct. As the gallbladder was also imaged with this technique, it was easy to determine at which layer to detach the gallbladder from the liver bed. The operative time was 1 h and 32 min, and blood loss was 5 ml. There were no perioperative complications.

1. Introduction

The PINPOINT endoscopic fluorescence imaging system (Novadaq, Mississauga, ON, Canada; Fig. 1) overlays fluorescent and color images in a synchronous manner, enabling the simultaneous visualization of normal color and fluorescent images [1]. Conventional fluorescence laparoscopy uses dark-field imaging, which makes non-fluorescent images difficult to visualize—surgery must be interrupted in order to switch images. The PINPOINT system enables the simultaneous viewing of fluorescent images and surgery can thus be performed without interruption. The PINPOINT system also allows toggling between normal color and fluorescent images as necessary.

Case report

A 43-year-old man presented to our hospital with pain in the right hypochondrium after meals. Blood work showed mild elevation of the white blood cell (WBC) count (11,210/μl) and C-reactive protein (CRP) level (1.70 mg/dl). There was no clear elevation of hepatobiliary enzymes. An abdominal computed tomography (CT) scan showed a high absorbance region in the neck of the gallbladder that suggested the presence of stones, but no thickening of the gallbladder wall or notable surrounding inflammation was observed (Fig. 2a). An abdominal magnetic resonance imaging (MRI) scan revealed no anomalies along the bile duct. The cystic duct branched from the middle portion of the bile duct, and there were no defects that suggested the presence of a stone in the common bile duct (Fig. 2b). Based on these findings, the patient was diagnosed with cholecystolithiasis and underwent surgery. This surgical procedure was approved by the Research Ethics Committee of the International University of Health and Welfare (Approval number 13-B-60).

At 6:00 PM on the day before surgery (18 h before the procedure), 10 ml of indocyanine green (ICG; 2.5 mg/ml) was injected intravenously. Laparoscopic cholecystectomy (LC) was performed via four ports. First, a minilaparotomy was performed on the lower abdomen, and a 12-mm trocar was inserted. After CO2 insufflation (intra-abdominal pressure of 10 mmHg), a 45° oblique-viewing endoscope was inserted. Under laparoscopic visualization, a 12-mm trocar was inserted approximately 5 cm caudal to the epigastric region, a 5-mm trocar was inserted along the midclavicular line under the right costal arch, and a 5-mm trocar was inserted along the anterior axillary line under the right costal arch. With the PINPOINT system, the gallbladder and cystic duct were imaged in green (Fig. 3). During the approach to the cystic duct, the peripheral tissue was detached, and the "critical view of safety" [2] proposed by Strasberg was verified before ligating the cystic duct using an endoscopic clip. Then, the cystic artery was ligated using an endoscopic clip. The gallbladder was adequately imaged with ICG fluorescence (Fig. 4a). The boundary between the gallbladder and the liver could be clearly visualized, and the gallbladder was detached easily from

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Fig. 1. The PINPOINT endoscopic fluorescence imaging system (Novadaq, Mississauga, ON, Canada; reprinted with permission from Novadaq Technologies Inc.).

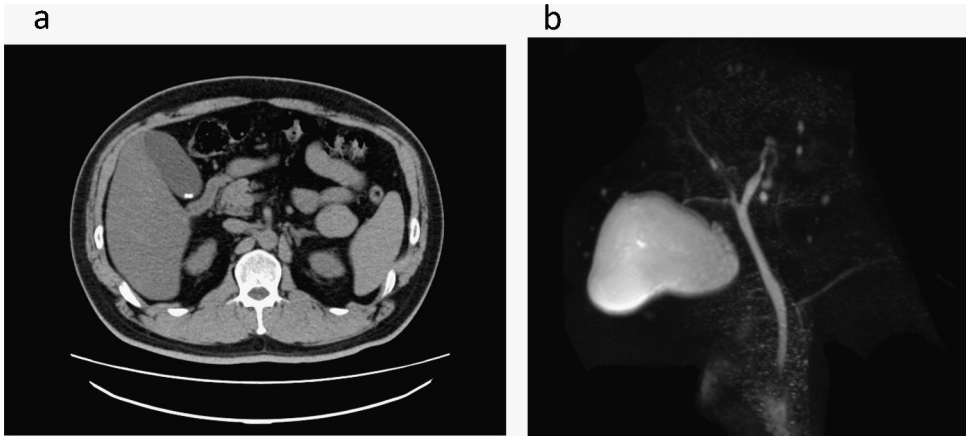

Fig. 2. a. A CT image showing a high absorbance region in the neck of the gallbladder suggesting the presence of a stone. No thickening of the gallbladder wall or increase in the concentration of surrounding fat is evident. Fig. 2b MRI did not indicate an anomaly along the bile duct. The cystic duct branches from the middle portion of the bile duct, and a defect that suggests the presence of a stone in the common bile duct was not observed.

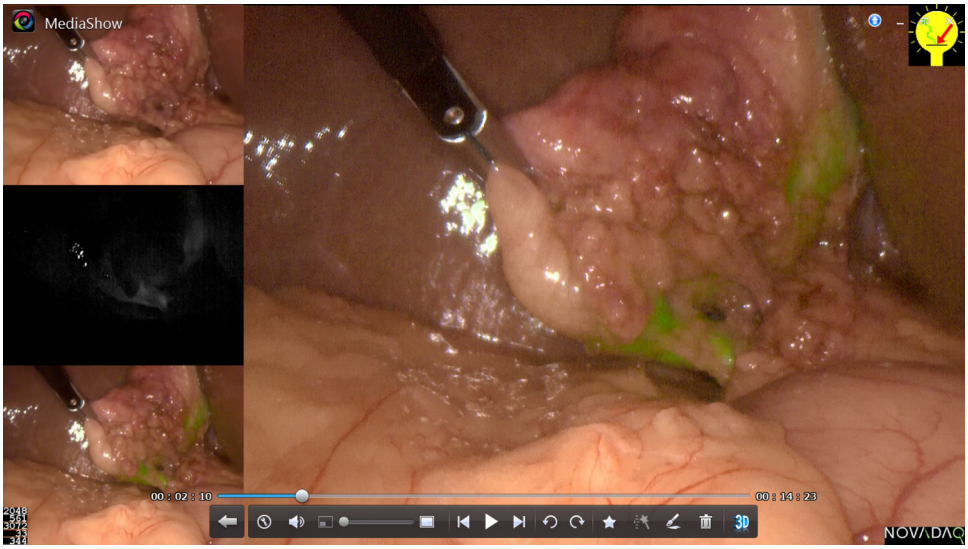

Fig. 3. Laparoscopic images after ICG administration. The gallbladder (arrowhead) and cystic duct (arrow) were imaged in green.

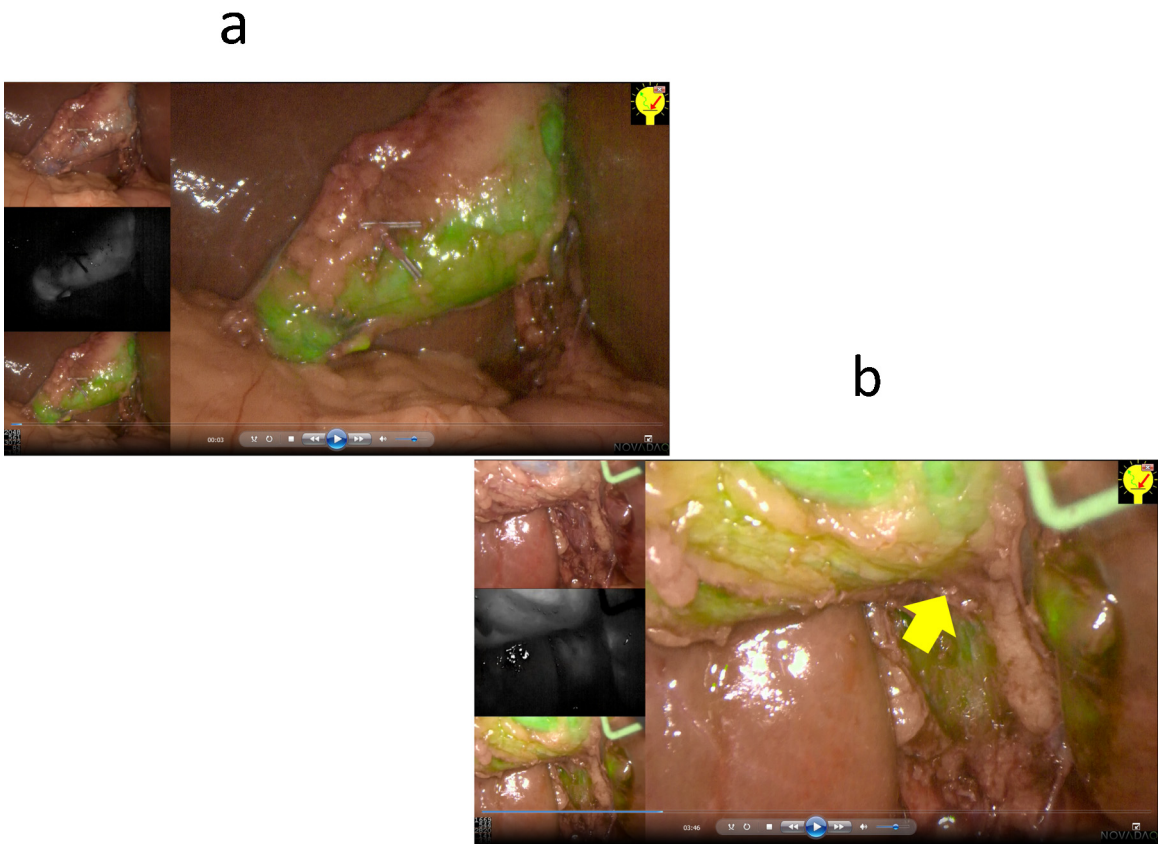

Fig. 4. a. The gallbladder was adequately imaged with ICG fluorescence. Fig. 4b The boundary between the gallbladder and liver was clearly visible (arrow), and the gallbladder could be detached easily.

the liver bed (Fig. 4b). The operative time was 1 h and 32 min, and blood loss was 5 ml.

3. Discussion

The bright field/color fluorescence camera of the HyperEye Medical System (HEMS; Mizuho Co., Tokyo, Japan) has been used in gastroenterological surgeries to visualize sentinel lymph nodes [3] and blood flow [4]. However, at the present time, HEMS cannot be used in laparoscopic surgeries.

LC to treat benign gallbladder disease was first performed in 1988 by Reddick and Olsen [5] and Dubois et al. [6], and has since been established as a standard operative procedure. Intraoperative bile duct injury is the most serious complication of LC, with an incidence rate of 0.3–0.4% [7–9]. To reduce this complication, LC using a fluorescent imaging technique with dark-field, black-and-white images was recently reported [10]. By intravenously injecting ICG

18 h before the surgery and visualizing with bright field/color fluorescence using the PINPOINT system, the cystic duct and common bile duct can be clearly imaged. The technique is thus advantageous in terms of preventing bile duct injury. The gallbladder can also be visualized, and since the ICG fluorescence of the liver is faint, the boundary between the gallbladder and the liver can easily be identified. Another advantage is that, by detaching the ICG-negative tissue adhered to the gallbladder, it is possible to detach the gallbladder at an appropriate layer without damaging the liver.

The case reported herein suggests that LC can be performed safely and effectively with the PINPOINT system, which enables surgery to be performed while simultaneously viewing fluorescent images.

Conflict of interests

The authors declare no conflict of interests for this article.

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None.

Ethical approval

Written informed consent was obtained from the patients for publication of these case reports and accompanying images.

Consent

This patient was properly informed and gave consent for her clinical information to be included in an Elsevier publication.

Author contribution

Nobuhiro Tsutsui performed the surgery, wrote the manuscript and is responsible for the information. Masashi Yoshida reviewed critically the manuscript and performed the surgery. Hironori Ohdaira reviewed critically the manuscript. Eisaku Ito performed the surgery. Nobuhiro Saito performed the surgery. Masaki Kitajima reviewed critically the manuscript. Yutaka Suzuki reviewed critically the manuscript.

Guarantor

Nobuhiro Tsutsui is the guarantor of this paper.

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